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(54) Method and means for increasing efficacy and wash durability of insecticide treated fabric

(57) This invention relates to the manufacture of fabric intend to be made into washable garments, and more specifically to the placement of an insecticide such as permethrin in the fabric by impregnation with polymeric binders and a cross-linking agent; or by surface coating with a polymeric binder and a thickening agent to improve the efficacy as an insect repellent and retention of the permethrin in the fabric as an effective insecticide through successive washings of the garments.

Fig. 2A

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Description

Field of The Invention:

This invention relates to the finishing of washable fabric intended to be made into wearing apparel and more specifically to the finishing of such fabric with an insecticide, such as permethrin, by a process that increases the knockdown efficacy and the retention of the insecticide in the fabric through successive washings.

Background of The Invention:

Permethrin is a synthetic pyrethroid which exhibits repellent as well as knockdown and kill activity against insects. Pyrethroids, including both the naturally occurring compounds and their synthetically prepared analogs effectively control a variety of pests, such as ticks, cockroaches, houseflies, mosquitoes, black flies, fleas, and other flying or crawling insects. Pyrethroids are not harmful to plants, food, animals or humans, and leave no harmful residues.

Despite these highly favourable characteristics, permethrin has had only limited general utility because of its relatively short-lived insecticidal activity. This is due to the decomposition of permethrin into a nonactive, non-insecticidal product in the presence of oxygen and ultraviolet light.

EP-A-O,605, 939 discloses a tent fabric with a water repellent and flame retardant coating that includes the insecticide permethrin. The patent teaches that placing the permethrin in the coating on the inner surface of the tent enables the tent fabric and outer surface coating to shield the permethrin from oxygen and ultraviolet light and thereby provide an effective life of more than six months for the permethrin.

EP-A-O,609,600 teaches that permethrin can be preserved in insect repellent fabrics by placing a barrier over the permethrin to protect the permethrin from degradation by ultraviolet light and oxygen.

Another problem with using permethrin as an insect repellent in washable clothing is retaining the permethrin in washable garments through successive wash cycles.

U.S. Patent No. 5,089,298 offers one solution to the problem of retaining permethrin in clothing-through successive wash cycles. This patent teaches that permethrin is retained in garments impregnated with permethrin and amylopectin, a water soluble form of starch, through a substantially greater number of launderings cycles than garments treated only with permethrin.

EP-A-o,731,208 teaches that an initial concentration in a fabric of approximately 1.25 grams of permethrin per square meter is strong enough to repel insects and also teaches that the addition of polyvinyl acetate as a binder for the permethrin dispersion preserves the effectiveness of the permethrin through more washings of the fabric than does the amylopectin of U.S. 5,089,298.

Applicant's research has continued for effective use of permethrin in repelling mosquitoes and other insects, and applicants have found polymeric binders other than the polyvinyl acetate disclosed in EP-A-o,731,208 to be effective in prolonging the durability of permethrin. Applicants have also found a process of applying permethrin to the fabric that effectively increases the repellency of insects and that maintains the effectiveness of permethrin after repeated launderings of the treated fabric.

Summary of The Invention:

EP-A-0,731,208 teaches the addition of polyvinyl acetate to the permethrin by first impregnating the fabric with polyvinyl acetate and then impregnating the fabric in a second tank with a permethrin dispersion that provides an initial concentration in a fabric of approximately 1.25 grams of permethrin per square meter which is more that enough to repel insects.

Applicants have now learned that a dispersion of permethrin and an effective polymeric binder can be effectively applied to the fabric by impregnation in a single tank.

Applicants have also discovered that permethrin can be effectively applied to the fabric in a surface coating on only one side of the fabric. There are, then, two embodiments of the present invention: (1) Impregnating the fabric with permethrin, and (2) Surface coating only one side of the fabric with permethrin.

In the first embodiment, fabric that is to be made into washable garments is dyed and finished in the normal manner and then impregnated with a suitable polymeric binder and with a dispersion of permethrin, and sometimes a cross-linking agent. In the second embodiment, only one side of any desired fabric is surface coated with an insecticide and thickener, and sometimes a suitable polymeric binder with or without a cross-linking agent.

Brief Description of The Drawings:

Figure 1 is a perspective view of fabric that has been treated with permethrin by impregnating the fabric with a dispersion of permethrin and a polymeric binder;

Figure 1A is an enlarged sectional view taken substantially along the line 1A-1A in Figure 1;

Figure 2 is a perspective view of fabric that has been treated with permethrin by surface coating one side of the fabric with a dispersion of permethrin and polymeric binder;

Figure 2A is an enlarged sectional view taken substantially along the line 2A-2A in Figure 2; and

Figures 3 and 4 are perspective views illustrating the apparatus and the procedures used in determining the effectiveness of permethrin as an insect repellent.

Detailed Description of The Invention:

The fabric or substrate with which this invention is used may be of any desired type. For example, the fabric may be a plain weave polyester fabric or a 65/35 blend of polyester and cotton suitable for manufacture of clothing. Alternatively, but not exclusively, the fabric may be intended for a military battle dress uniform made of either 100% rip-stop cotton or 50% nylon and 50% cotton.

A permethrin dispersion that provides approximately 1.25 grams of permethrin per square meter in a selected fabric was used to find the effectiveness of polymeric binders; and cross-linking agents as synergists to prolong the retention of permethrin in washable fabrics.

The exact amount of permethrin to be added depends on the type of fabric being treated. Different fabric absorb or assimilate different amounts of the permethrin dispersion. The exact amount of permethrin is determined by successive trials to find the amount necessary to provide an initial concentration in the selected fabric of approximately 1.25 grams of permethrin per square meter. That initial concentration has been found to provide effective insecticide properties and/or insect contact repellency.

The First Embodiment - Impregnation

Figures 1 and 1A illustrate a fabric 10 that has been impregnated with a solution containing a dispersion of permethrin and a polymeric binder. The permethrin and the polymeric binder are indicated by dots 11 in Figure 1A. As seen in the sectional view of Figure 1A, the dots 11 are spread throughout the fabric 10. Permethrin is spread throughout the fabric in the same way when the permethrin is applied to fabric by impregnating the fabric in a bath containing only permethrin.

Fabrics have been impregnated with several solutions, each of which contain the same dispersion of permethrin and the same percentage of different polymeric binders and/or cross-linking agents. The treated fabrics were then subjected to home launderings and the percentage of permethrin then remaining in the fabric was measured to compare the effectiveness of the binders in retaining permethrin in the fabric.

Examples of Impregnating Fabric with Permethrin

Example I

Example I is a comparison of Example I-A with Example I-B to determine the retention of permethrin in fabric after one washing of the treated fabric.

Example I-A Impregnates the Fabric with Only Permethrin.
Example I-B Impregnates the Fabric with Permethrin and an Acrylic Binder.

In this first example, the fabric substrate is a 65/35 cotton/polyester blend.

In Example I-A, the fabric was impregnated with a permethrin dispersion.

In Example I-B, the fabric was impregnated with a permethrin dispersion **and** with a solution of ten (10) ounces of acrylic copolymer per gallon as a binder.

Retention of Permethrin in Example I

Example I-A 30.8% after 5 Home Launderings; 11.9% after 10 Home Launderings.
Examples I-B 58.8% after 5 Home Launderings; 47.1% after 10 Home Launderings.

Comment on Example 1: The addition of an acrylic binder improves the retention of permethrin after the fabric is washed.

Example II

Example II is a comparison of Example II-A with Example II-B to determine the retention of permethrin in fabric after five washings of the treated fabric.

Examples II-A Impregnates the Fabric with Permethrin and Polyvinyl Acetate.
Example II-B Impregnates the Fabric with permethrin and Acrylic.

In this second example, the fabric substrate is a 65/35 cotton/polyester blend.
In example II-A the fabric was impregnated with a permethrin dispersion and with a solution of ten (10) ounces of polyvinyl acetate per gallon as a binder.
In Example II-B the fabric was impregnated with a permethrin dispersion and with a solution of ten (10) ounces of acrylic copolymer per gallon as a binder.

Retention of Permethrin in Example II

Example II-A 37.0 percent after 5 Home Launderings.
Example II-B 58.8 percent after 5 Home Launderings.

Comment on Example II: Use of an acrylic binder yields better laundering durability than use of polyvinyl acetate binder.

Example III

Example III is a comparison of Example III-A with Example III-B to determine the retention of permethrin in fabric after five washing of the treated fabric.

Example III-A Impregnates the Fabric with permethrin and Polyvinyl Acetate.
Example III-B Impregnates the Fabric with Permethrin, with Polyvinyl Acetate and with a Cross-Linking Agent.

In this third example, the fabric substrate is a 65/35 cotton/polyester blend.
In example III-A the fabric was impregnated with a permethrin dispersion and with a solution of ten (10) ounces of polyvinyl acetate per gallon as a binder.
In Example III-B, the fabric was impregnated with a permethrin dispersion, with a solution of ten (10) ounces of polyvinyl acetate per gallon as a binder, and with 0.5 ounces per gallon of methylated melamine resin as a cross-linking agent.

Retention of Permethrin in Example III

Example III-A 37.0 percent after 5 Home Launderings.
Example III-B 54.2 percent after 5 Home Launderings.

Comment on Example III: Use of a polyvinyl acetate binder and a cross-linking agent yields better laundering durability of permethrin than does use of polyvinyl acetate binder alone.

The Second Embodiment - Surface Coating

Figures 2 and 2A illustrate a fabric 20 that has been surface coated with a solution containing a dispersion of permethrin, a polymeric binder and a thickening agent The permethrin the polymeric binder and the thickening agent are indicated by the dots 22 in Figure 2A, the dots 22 are spread throughout a layer on only one major surface of the fabric 20. There are no dots 22 in the body of the fabric 20. Similarly, there is no permethrin in the body fabric that is surface coated with permethrin.
Fabrics have been surface coated on only one side with several solutions, each of which contain the same dispersion of permethrin, a thickener, and the indicated concentrations of different polymeric binders and/or cross-linking agents. The treated fabrics were then subjected to home launderings and the percentage of permethrin remaining on the fabric was measured to compare the effectiveness of the binders in retaining permethrin on the fabric.

Examples of Surface Coating

Example IV

Example IV is a comparison of Example IV-A with Example IV-B to determine the retention of permethrin in fabric after five washings of the treated fabric.

Example IV-A Surface Coats the Fabric with Only Permethrin and a Thickening Agent.
Example IV-B Surface Coats the Fabric with Permethrin, a Thickening Agent and an Acrylic binder.

In the fourth example, the fabric substrate is a 65/35 cotton/polyester blend.

In Example IV-A, the fabric was surface coated with only a permethrin dispersion and carboxymethylcellulose as a thickening agent.

In Example IV-B, the fabric was surface coated with a permethrin dispersion with a 10% w/w solution of acrylic copolymer emulsion as a binder, and with carboxymethylcellulose as a thickening agent.

Retention of Permethrin in Example IV

Example IV-A 25.2 percent after 1 Home Laundering
Example IV-B 42.9 Percent after 1 Home Laundering.

Comments on Example IV: The addition of an acrylic binder to permethrin and a thickening agent yields better laundering durability than is obtained by merely adding a thickening agent to the permethrin.

Example V

Example V is a comparison of Example V-A with Example V-B to determine the retention of permethrin in fabric after five washings of the treated fabric.

Example V-A Surface Coats the Fabric with Permethrin, a Polyvinyl Acetate Binder, and a Thickening Agent.
Example V-B Surface Coats the Fabric with Permethrin, a Polyvinyl Acetate Binder, a Thickening Agent, and a Cross-Linking Agent.

In the fifth example, the fabric substrate is a 65/35 cotton/polyester blend.

In Example V-A, the fabric was surface coated with a permethrin dispersion with a 10% w/w solution of polyvinyl acetate per gallon as a binder and carboxymethylcellulose as a thickening agent.

In Example V-B, the fabric was surface coated with a permethrin dispersion, with a 10% w/w solution of polyvinyl acetate emulsion as a binder, with 0.5% w/w of methylated melamine resin as a cross-linking agent, and with carboxymethylcellulose as a thickening agent.

Retention of Permethrin in Example V

Example V-A 63.3% after 5 Home Launderings; 59.0% after 10 Home Launderings.
Example V-B 65.2% after 5 Home Launderings; 59.0% after 10 Home Launderings.

Comment on Example V: The addition of cross-linking agent to a polyvinyl acetate binder in a thickened coating does not significantly increase the retention of permethrin in the fabric after repetitive laundering.

Example VI

Example VI is a comparison of Example VI-A Example VI-B to determine the retention of permethrin in fabric after one home washing of the treated fabric.

Example VI-A Surface Coats the Fabric with Permethrin, a Polyvinyl Acetate Blinder and a Thickening Agent.
Example VI-B Surface Coats the Fabric with Permethrin, an Acrylic Binder and a Thickening Agent,

In the sixth example, the fabric substrate is a 65/35 cotton/polyester blend.

In Example VI-A, the fabric was surface coated with a permethrin dispersion, with a 10 % w/w solution of polyvinyl acetate emulsion as a binder, and carboxymethylcellulose as a thickening agent.

In example VI-B the fabric was surface coated with a permethrin dispersion, with 10% w/w solution of acrylic copolymer emulsion as a binder and carboxymethylcellulose as a thickening agent.

Retention of Permethrin in Example VI

Example VI-A 42.7% after 1 Home Laundering.
Example VI-B 42.9% after 1 Home Laundering.

Comments on Example VI: The addition of an acrylic binder to a thickened surface coating does not more significantly increase laundering durability than does the addition of a polyvinyl acetate binder.

Example VII

Example VII is a comparison of Example VII to determine the retention of permethrin in fabric after five home washing of the fabric.

Example VII-A surface coats the fabric with permethrin, a Polyvinyl Acetate Binder and a Thickening Agent.
Example VII-B Surface coats the fabric with permethrin a polyvinyl Acetate Binder, a Thickening Agent and a Cross-Linking Agent.

In the seventh example the fabric substrate is a 65/35 cotton/polyester blend.

In example VII-A the fabric was surface coated with a permethrin dispersion with a 10% w/w solution of polyvinyl acetate emulsion as a binder and carboxymethylcellulose as a thickening agent.

In Example VII-B the fabric was surface coated with a permethrin dispersion, with a 10% w/w solution of polyvinyl acetate emulsion as a binder carboxymethylcellulose as a thickening agent and 0.5% by volume of a methylated melamine resin as a cross-linking agent.

Retention of permethrin in Example VII

Example VII-A 52.7% after 5 Home Launderings.
Example VII-B 47.8% after 5 Home Launderings.

Comment on Example VII: The use of a cross-linking agent with a polyvinyl acetate binder does not improve the laundering durability over the uce of polyvinyl acetate binder alone.

Example VIII

Example VIII is a comparison of three surface coatings: Example VIII-A, Example VIII-B, and Example VIII-C to determine the retention of permethrin in 100% cotton rip-stop fabric for battle dress uniforms after repetitive home launderings of the fabric.

Example VIII-A is a Thickened Coating of Only Permethrin.
Example VIII-B is a Thickened Coating of Permethrin with an Acrylic Binder.
Example VIII-C is a Thickened Coating of Permethrin with an Acrylic Binder and a cross-linking agent.

In the eighth example the fabric substrate is a 100% cotton Rip-Stop fabric intended for a military battle dress uniform.

In Example VIII-A the fabric was surface coated with a permethrin dispersion, and carboxymethylcellulose as a thickening agent.

In Example VIII-b, the fabric was surface coated with a permethrin dispersion, with a 10% w/w solution of an acrylic copolymer emulsion as a binder, and carboxymethylcellulose as a thickening agent.

In Example VIII-C, the fabric was surface coated with a permethrin dispersion, with a 10% w/w solution of an acrylic copolymer emulsion as a binder, carboxymethylcellulose as a thickening agent, and 0.5% w/w of a methylated melamine resin as a cross-linking agent.

Retention of Permethrin in Example VIII

	After 1 Home Laundry	After 5 Home Laundries	After 10 Home Laundries
Example VIII-A	59.5%	30.2%	4.76%
Example VIII-B	86.4%	46.2%	18.2%
Example VIII-C	74.8%	39.9%	23.8%

Comments on Example VIII: The use of an acrylic binder significantly improves the laundering durability of permethrin, and the addition of a cross-linking agent further improves the laundering durability of permethrin.

Example IX

Example IX is a comparison of three surface coatings: Example IX-A, Example IX-B, and Example IX-C to determine the retention of permethrin in 50/50 nylon/cotton fabric for battle dress uniforms after repetitive home launderings of the fabric.

Example IX-A is a Thickened Coating of Only Permethrin.
Example IX-B is a Thickened Coating of Permethrin with an Acrylic Binder.
Example IX-C is a Thickened Coating of Permethrin with an Acrylic Binder and a cross linking agent.

In the ninth example the fabric substrate is a 50/50 nylon/cotton fabric intended for battle dress uniform.

In Example IX-A, the fabric was surface coated with a permethrin dispersion, and carboxymethylcellulose as a thickening agent.

In Example IX-B the fabric was surface coated with a permethrin dispersion, with a 10% w/w solution of an acrylic copolymer emulsion as a binder, and carloxymethylcellulose as a thickening agent.

In Example IX-C the fabric was surface coated with a permethrin dispersion, with a 10% w/w of acrylic copolymer emulsion as a binder carboxymethyl-cellulose as thickening agent, and 5% by volume of methylated melamine resin as a cross-linking agent.

Retention of Permethrin in Example IX

	After 1 Home Laundry	After 10 Home Laundries	After 20 Home Laundries
Example IX-A	47.4%	Trace	None
Example IX-b	77.7%	29.9%	5.98%
Example IX-C	66.4%	35.4%	8.85%

Comment on Example IX: The use of an acrylic binder significantly improves the laundering durability of permethrin and the addition of a cross-linking agent further improves the laundering durability of permethrin.

Example X

Example X is a comparison of Example X-A with Example X-B to determine the retention of permethrin in fabric after five washing of the treated fabric.

Example X-A Impregnates the Fabric with Only Permethrin.
Example X-B Surface Coats the Fabric with Only Permethrin and a Thickening Agent.

In the tenth example the fabric substrate is a 65/35 cotton/polyester blend.

In Example X-A the fabric was impregnated with only a permethrin dispersion.

In Example X-B the fabric was surface coated with only a permethrin dispersion and carboxymethylcellulose as a thickener.

Retention of Permethrin in Example X

Example X-A 30.8 percent after 5 Home Launderings.
Example X-B 39.7 percent after 5 Home Launderings.

Comments on Example X: Surface coating the permethrin on one side of the fabric substrate with a thickening agent yields better laundering durability than impregnating the fabric with permethrin.

The Home Laundering Procedure

All of the home launderings in the foregoing examples were done in a KENMORE Ultra Fabric Care Heavy Duty 80 Series Residential Washing Machine. The sample was weighed and ballast fabrics were used to bring the load weight to four pounds. A 50 ml. beaker of ALL detergent was measured and added to the load. The Washing machine was programmed for its normal cycle at its regular setting. The fabrics were washed in hot water (120°F.), with a cold rinse. After each wash cycle, the load was dried with medium heat for 20 minutes in a HUEBSCH ORIGINATORS 30 Plus Commercial Dryer and cooled for 5 minutes.

The Test Procedure

The instrument and test procedure that were used for determining the quantity of permethrin remaining in the fabric after launderings is set forth below: **Gas Chromatography (GC):**

Tre Metrics 541: Electon Capture Detector
Column: 6- foot by 1/8 inch I.D. glass column packed with 3% OV 225 on 100/120 mesh Gas Chrome Q or equivalent.
Gas: 5% Methane, 95% Argon
Condition:

Oven Temperature:	245°C
Injector Temperature:	225°C
Detector Temperature:	350°C
Injection Volume:	2ul
Carrier gas flow rate:	50ml/minute
Run Time:	Approximately 20 minutes per sample.

Test Procedure:

Place each 12 square inches of the test specimen into a Soxhlet extraction thimble. This is prepared by cutting three layers of the test fabric with a 2" x 2" die. Add 175 ml. of acetonitrile/methanol mixture and several boiling chips into a 250 ml. heat resistance flask. Assemble the Soxhlet extraction apparatus and extract the permethrin impregnated specimens for 6 hours. After extraction, the extract is to be diluted to 200 ml. total volume in a volumetric flask. Inject 1 ul of the extract into the GC.

Calculations:

A series of standard solutions of Permethrin are injected into the GC, integration of the two cis and trans peaks are recorded. A linear plot of the integrated area of both cis and trans peaks vs. Concentration is created, and the equation of the line recorded. Using the equation of the line and interacted area of an unknown's peaks, extrapolation to the unknowns concentration can be accomplished. This is to be reported in units of grams per square meter.
Note: If the linear plot's concentration axis is in units of grams per square meter, the extrapolation is expedited.

The Increased Efficacy of Surface Coating

Fabrics that are surface coated with permethrin have a greater insect repellent efficacy that fabrics that are impreg-

nated with equal amounts of permethrin. One reason is apparent from a comparison of the physical location of permethrin in the fabric of Figure 2A with the physical location of permethrin in the fabric of Figure 1A.

In Figure 2A all of the permethrin is located on only one major surface of the fabric. When that major surface becomes the outer surface of a garment, all of the permethrin is positioned to contact insects. At the same time it is positioned our of contact with the skin of the wearer.

In figure 1A the same quantity of permethrin is dispersed throughout the body of the fabric. Consequently, only the portion of the permethrin that is located on the surface of the fabric that becomes the outer surface of a garment is available for the repellency of insects. The rest of the permethrin is scattered throughout the fabric, as shown in Figure 1A with as much of the permethrin on the inside of a garment made from fabric as there is on the outside.

Figures 3 and 4 illustrate the apparatus and procedure used in an actual test that has confirmed the increased efficacy of surface coated permethrin in repelling insects. That test is the subject of Examples XI and XII.

As indicated in Figure 3, the test was carried out by placing an inverted petri dish cover 30 on a card 31 that is positioned sequentially on differently treated pieces of fabric 32. One piece of fabric 32 was treated in accordance with Example XI, and another piece of fabric was treated in accordance with Example XII.

In each test, ten female aedes aegypti mosquitoes 33 were confined in the petri dish cover 30, as noted in Figure 3, and card 31 was gently slid from beneath the petri dish cover, allowing the mosquitoes to be in direct contact with the treated fabric 32. After the mosquitoes are exposed to the treated fabric 32 for an allotted time (5 to 60 minutes) the card 31 was gently returned to its initial position beneath the petri dish cover to terminate the mosquitoes' exposure to the treated fabric. Knockdown counts are recorded 15 and 60 minutes after the mosquitoes are first exposed to the treated fabric by removal of the card 31.

Example XI

Impregnation

Formula	
Water	98%
Permethrin	2%
Calculated concentration of permethrin grams per square meter.	1.14
Analysed concentration of permethrin grams per square meter.	1.17
The fabric face was exposed to insects in a enclosure for 5 minutes. After 15 minutes, 25% of the aedes aegypti mosquitoes were knocked down. After 60 minutes, 80% of the aedes aegypti mosquitoeswere knocked down.	

Example XIH

Surface Coated

Formula	
Water	92.5%
Permethrin	5.5%
Methocel	2.0% (Thickener)
Calculated concentration of permethrin grams per square meter	1.25
Analysed concentration of permethrin grams per square meter.	0.85
The fabric face was exposed to insects in an enclosure for 5 minutes. After 15 minutes, 50.0% of the aedes aegypti mosquitoes were knocked down. After 60 minutes, 95.0% of the aedes aegypti mosquitoes were knocked down.	

It is apparent from this data that the surface treatment creates a more efficacious pest control fabric, which

achieves quicker and greater knockdown than the impregnated fabric.

Another advantage of surface coating fabric intended for garments is that a surface coating in the outside of the garment minimises skin contact to the wearer and maximises the location of permethrin for the contact by insects.

There is thus provided an improved method of increasing the durability of permethrin to repeated launderings of a treated fabric and an improved method of increasing the efficacy of an insecticide to repel insects. Although all of the examples herein have utilised permethrin as the insecticide, the described methods may be used with other insecticides within the scope of the invention.

Although specific terms have been used in describing the invention they have been used in a descriptive sense only, and not for the purpose of limitation.

Claims

1. A method of enhancing the efficacy of fabric to repel insects before and after successive washings of the fabric, said method characterised by comprising the steps of:

   (a) providing a solution containing a dispersion of an insecticide in a thickening agent; and
   (b) surface coating the solution on only one major surface of the fabric, the thickening agent functioning to dispose the insecticide essentially on but the one major surface of the fabric which was coated.

2. A method as claimed in claim 1 characterised in that the insecticide is permethrin.

3. A method as claimed in claim 1 or 2 characterised in that the solution includes a polymeric binder.

4. A method as claimed in claim 3 characterised in that the polymeric binder is polyvinyl acetate.

5. A method as claimed in claim 3 characterised in that a polymeric binder is acrylic copolymer.

6. A method as claimed in any preceding claim characterised in that the thickening agent is carboxymethylcellulose.

7. A method as claimed in any preceding claim characterised in that the solution includes a cross-linking agent.

8. A method as claimed in claim 7 characterised in that the cross-linking agent is methylated melamine resin.

9. A fabric intended to be used in the manufacture of washable garments, the fabric containing permethrin and characterised by means for retaining the permethrin in the fabric as an effective insecticide after the fabric has been made into garments and passed through successive wash cycles, said means comprising a polymeric binder of polyvinylacetate and a cross-linking agent.

10. A fabric having a coating disposed essentially on but one major surface thereof which functions as a means for repelling insects before and after successive washings of the coated fabric, characterised by said coating having been derived from a solution containing a dispersion of an insecticide in a thickening agent, the thickening agent having functioned to limit disposition of insecticide to said one major surface.

11. A fabric as claimed in claim 10 or 11 characterised in that the insecticide is permethrin.

12. A fabric as claimed in claim 10 or 11 characterised in that the solution includes a polymeric binder.

13. A fabric as claimed in claim 12 characterised in that the polymeric binder is polyvinyl acetate.

14. A fabric as claimed in claim 12 characterised in that the polymeric binder is an acrylic copolymer.

15. A fabric as claimed in anyone of claims 10 to 14 inclusive characterised in that the solution includes a cross-linking agent.

16. A fabric as claimed in claim 9 or 15 characterised in that the cross-linking agent is methylated melamine resin.

17. A fabric as claimed in claim 9 or claim 9 and 16 characterised in that the permethrin and means for retaining the permethrin in the fabric are impregnated in the fabric.

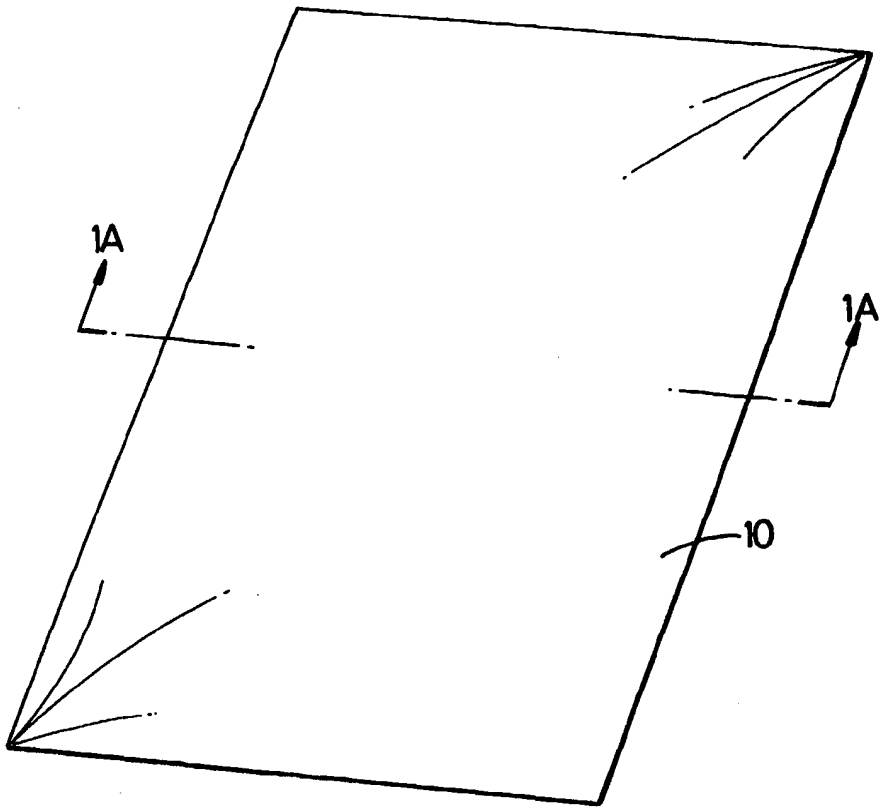

Fig. 1

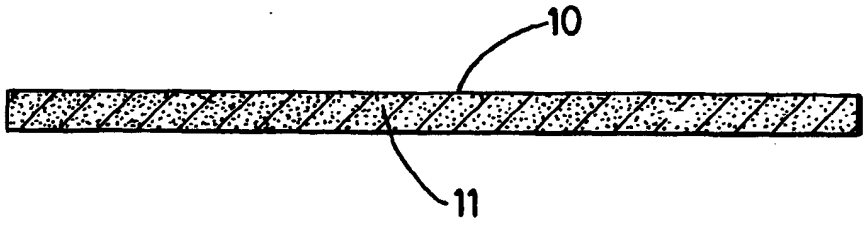

Fig. 1A

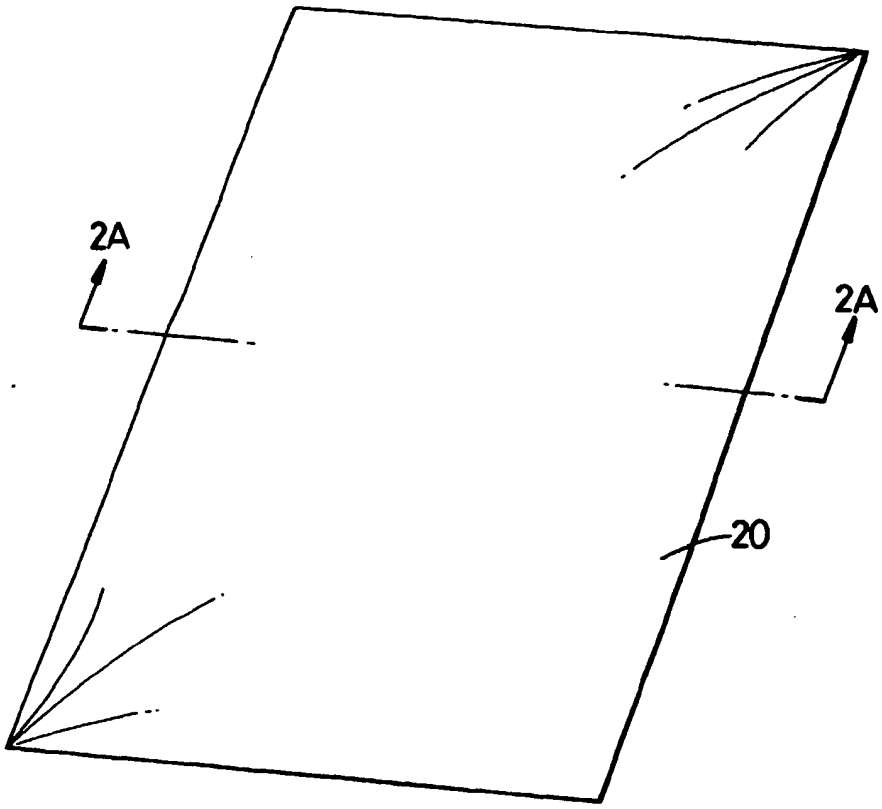

Fig. 2

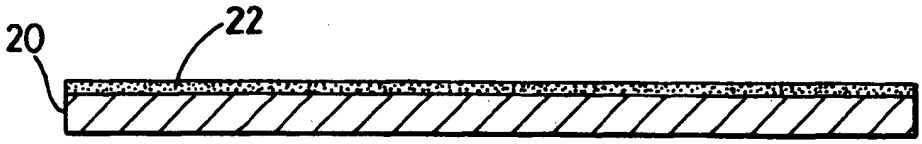

Fig. 2A

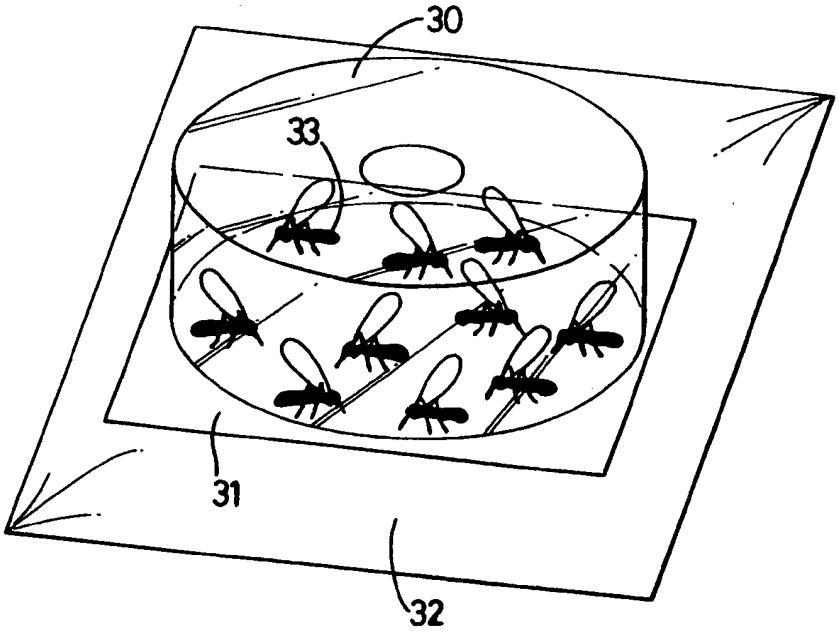

Fig. 3

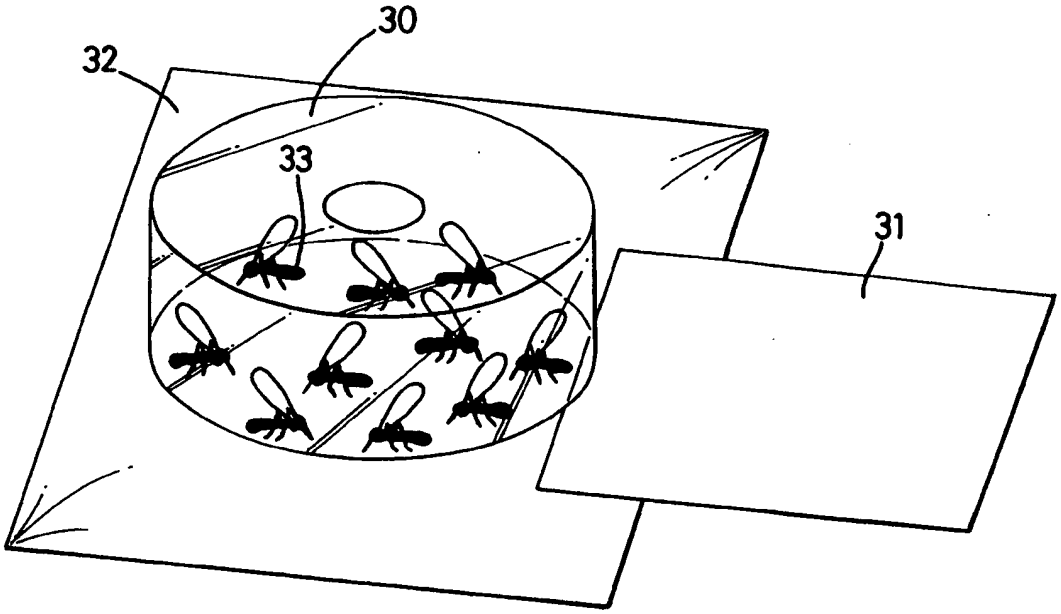

Fig. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 8225

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X,D A	EP 0 609 600 A (GRANITEVILLE CO) 10 August 1994 * page 3, line 18 - page 4, line 14 * * example 3 * * claims 6-9 *	1-3,5,7, 8,10-12, 14-16 4,6,9,13	D06M16/00 D06M15/333 D06M15/09 D06M15/263 D06M15/423
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A	EP 0 382 382 A (ICI PLC) 16 August 1990 * page 1, line 13 - page 3, line 31 *	1-5, 9-14,17	
A,D	US 5 089 298 A (MCNALLY BARTLEY F ET AL) 18 February 1992 * column 1, line 45 - column 2, line 17 *	1-3,9,17	
X,D, P	EP 0 731 208 A (GRANITEVILLE CO) 11 September 1996 * page 1, line 52 - line 54 * * page 4, line 20 - line 27 * * claims *	1-4, 9-13,17	TECHNICAL FIELDS SEARCHED (Int.Cl.6) D06M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 May 1997	Herrmann, J

CATEGORY OF CITED DOCUMENTS

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